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Ultrasonic Attenuation As A Function of Plastic Deformation in Aluminum. Part II, II

by

Witold Sylwestrowicz and Rohn Truell

15
Report Prepared for Watertown Arsenal
under Contract DA-19-020-ORD-2598

November 1953

14
Report DA-2598/9

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II

By

Witold Sylwestrowicz and Rohn Truell

Brown University

Report prepared for
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ULTRASONIC ATTENUATION AS A FUNCTION OF PLASTIC DEFORMATION IN ALUMINUM

II

This report is a continuation and extension of the work reported in report DA 2598/5 hereafter referred to as I. This report, hereafter referred to as II, has the same title as I.

In I a curve showing stress as a function of plastic strain was presented for 2S aluminum together with a corresponding curve showing ultrasonic attenuation as a function of plastic strain for the same samples. The samples were the usual tensil specimens from the center of which a 1/2" section was cut. The attenuation-strain curve in I was taken at 9 mc/sec and the range of plastic strain was 0.04% to 4.1%. The aluminum was annealed before straining.

In this report II the attenuation-strain data has been extended to higher frequencies. Using the same samples as in I the attenuation strain curves (Figure 1) are shown at 9, 12, 20, and 28 mc/sec. The general character of these curves is as it was at 9 mc/sec except th t the attenuation rises more rapidly with strain at higher frequencies. The data presented is surprisingly reproducible from one group of specimens to another group of specimens.

An interesting feature of this data becomes apparent when the attenuation is shown as a function of frequency for various values of permanent deformation as in Figure 2.

It appears that for the range of plastic deformation covered there is a simple relation of the form $\alpha = \alpha_0 + \sigma_1(s)v$ and that the amount of permanent deformation can be specified by an angle.

Whether from dislocation ideas a theory can be constructed to account for this behavior we have not yet determined. Dr. Kurt Lucke is now working on this problem in our laboratory. It is almost certain that with this aluminum there is some precipitation during deformation; this question will be settled when the experiment is done with high purity aluminum. Since both dislocations and precipitation affect the attenuation, the matter becomes more complex with the two effects present.

Experiments are now underway where the permanent deformation has been carried to about 10%, and experiments on high purity aluminum are planned.

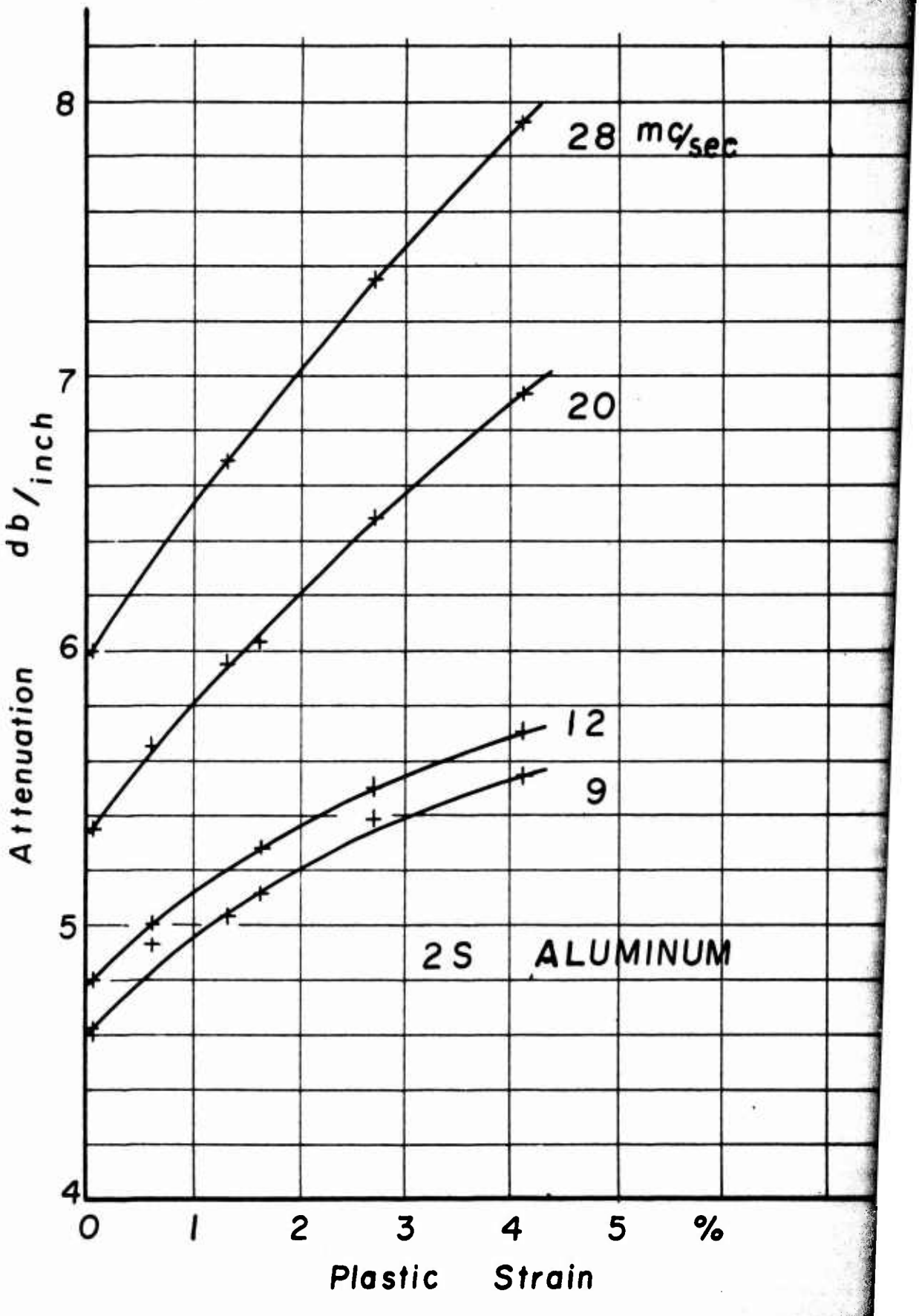
8
7
6
5
4
Attenuation db/inch
28 mc/sec
20
12
9
2S ALUMINUM
0
1
2
3
4
5
%
Plastic Strain

FIGURE 1

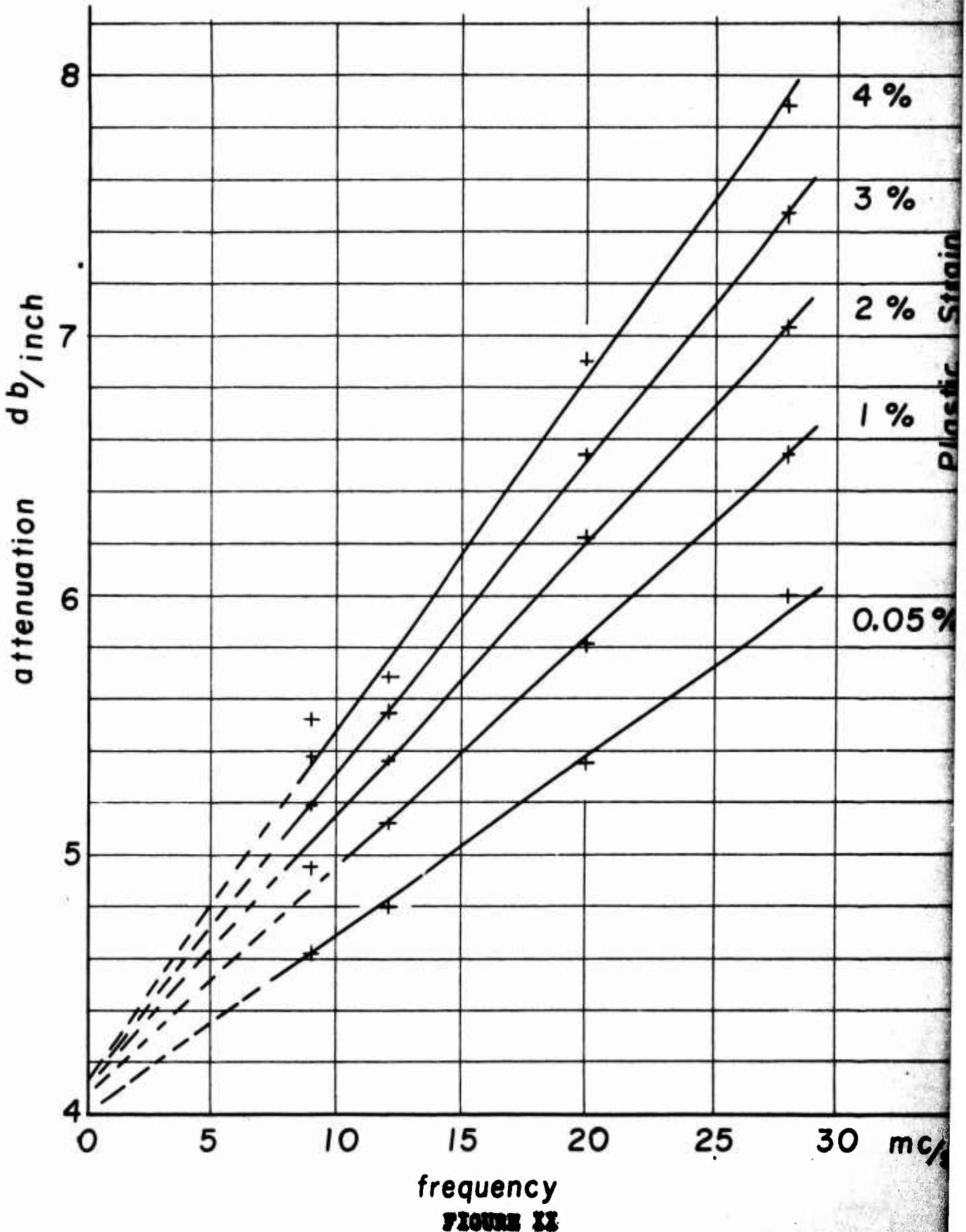
8
7
6
5
4
attenuation db/inch
0
5
10
15
20
25
30
mc/s
frequency
4 %
3 %
2 %
1 %
0.05 %
Plastic Strain

FIGURE II